**Understanding of Oxygen Reduction Kinetics Enhancement on Epitaxial Oxide Thin Films and Heterostructured Surfaces for Solid Oxide Fuel Cells**

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Electrocatalytic activities for ORR of epitaxial thin films of (La,Sr)MO3-**δ** and La2-xSrxMO4±**δ** (M=Mn, Fe, Co, and Ni) and their heterostructures have been studied. These films are grown with Pulsed Laser Deposition (PLD) and measured on patterned microelectrodes. Measurements are done using microprobes for in-depth linear electrochemical impedance spectroscopy (EIS) studies as a function of temperature, pO2, and overpotential. Various material characterization methods such as X-ray diffraction, Auger electron spectroscopy (AES), and X-ray photoelectron spectroscopy (XPS) are used to investigate how the surface and bulk chemistry change during oxygen reduction. By bringing together well-characterized thin film structure, EIS, material characterization techniques, modeling, and rate analysis, the molecular processes and oxide surface chemistry key to oxygen reduction activity enhancement are revealed. These studies elucidate fundamental factors that can enable development of highly active catalysts for high temperature O2 electrocatalysis.